# Module 21
# Verifying the Weight of the Lift

## Learning Objectives

By the end of this section, you will:

1. Know information that can be used to determine weight of a load.
2. Know devices on cranes that can weigh loads.
3. Be able to calculate the weight of a load.

**Always establish the weight before making a lift. The weight must be within the crane's capacity.**

***What sources of information can we use to determine the weight of the lift?***

» Drawings.

» Erection plans.

» Shipping bills.

» Painted / welded on the load.

» Parts manuals.

» Catalogs.

» Handbooks.

**Weight should be determined using available information. Weights listed on any form should be double checked ... for obvious reasons!**

**Loads can also be weighed with devices on the crane, not to exceed 75% of the crane's rated capacity:**

- Dynamometer.
- Wire rope weighing scale.
- Load moment system.

OSHA®

1926.1417 (o)(3)(i)(ii)

**When information is not available, weight should be estimated or calculated.**
**Weight = unit weight x volume**

**Calculations should use established unit weights.**

**If material is not listed, DO NOT guess! ASK!**

***Let's look up some common material densities on this page and next.***

» Portland Cement ____94____ lbs./cu.ft.

» #5 Reinforcing Bars ____1.043____ lbs./ft.

» Std. weight 12" pipe ____49.56____ lbs./ft.

» Steel ____490____ lbs./cu.ft.

| Weights of Reinforcing Bars | | |
|---|---|---|
| | | |
| **Imperial Weight** | | |
| | **lbs/ft** | **kg/m** |
| #3 | 0.376 | 0.56 |
| #4 | 0.668 | 0.994 |
| #5 | 1.043 | 1.552 |
| #6 | 1.502 | 2.235 |
| #7 | 2.044 | 3.042 |
| #8 | 2.67 | 3.973 |
| #9 | 3.4 | 5.06 |
| #10 | 4.303 | 6.404 |
| #11 | 5.313 | 7.907 |
| #14 | 7.65 | 11.384 |
| #18 | 13.6 | 20.239 |
| | | |
| **Metric Mass** | | |
| | **kg/m** | **lb/ft** |
| 10M | 0.785 | 0.528 |
| 15M | 1.57 | 1.055 |
| 20M | 2.355 | 1.583 |
| 25M | 3.925 | 2.638 |
| 30M | 5.495 | 3.693 |
| 35M | 7.85 | 5.275 |
| 45M | 11.775 | 7.912 |
| 55M | 19.625 | 13.188 |

| Weights of Materials | | |
|---|---|---|
| | **lbs/cu.ft.** | **kg/cu.m.** |
| **Construction Materials** | | |
| Cement - Portland | 94 | 1505 |
| Concrete - Stone | 144 | 2340 |
| Concrete - Reinforced | 150 | 2400 |
| Earth - Loose, Dry | 76 | 1220 |
| Wet, Packed | 96 | 1540 |
| Gravel - Dry, Loose | 110 | 1760 |
| Wet, Packed | 113 | 1810 |
| Granite | 167 | 2675 |
| Limestone | 165 | 2645 |
| Coal | 56 | 899 |
| Timber - Cedar | 22 | 360 |
| Seasoned - Fir, Douglas | 32 | 515 |
| Unseasoned - Fir, Douglas | 40 | 640 |
| Wet - Fir, Douglas | 50 | 800 |
| Glue Laminated - Fir, Douglas | 34 | 544 |
| Hemlock | 30 | 480 |
| Poplar | 30 | 480 |
| Spruce | 28 | 448 |
| Oak | 50 | 800 |
| Pine | 34 | 540 |
| **Metals** | | |
| Aluminum | 165 | 2640 |
| Bronze | 509 | 8150 |
| Cast Iron | 442 | 7080 |
| Lead | 710 | 11370 |
| Steel | 490 | 7850 |
| Tin | 460 | 7360 |
| **Liquids** | | |
| Pure Alchohol | 49 | 784 |
| Gasoline | 42 | 675 |
| Oils | 58 | 930 |
| Water | 63 | 1000 |
| **Micellaneous** | | |
| Coal | 56 | 900 |
| Glass | 162 | 2600 |
| Paper | 58 | 930 |
| Rubber | 94 | 1500 |
| Asbestos | 153 | 2450 |

| Weights of Materials | | |
|---|---|---|
| | **lbs/sq.ft.** | **kg/sq.m.** |
| **Corrugated** | | |
| 12 G.A. | 5.5 | 27 |
| **Steel Sheets** | | |
| 14 G.A. | 4 | 20 |
| 16 G.A. | 3 | 15 |
| 18 G.A. | 2.5 | 12 |
| 20 G.A. | 2 | 10 |
| 22 G.A. | 1.5 | 7 |
| **Steel Plate** | | |
| per inch | 40 | 195 |

## Concrete Bucket Sizes and Weights

| Bucket Size cu. yd. | Outside diameter, inches | Loading height, inches | Weight, lb. LW* | GP* | HW* |
|---|---|---|---|---|---|
| 1/3 | 38 | 34 | 240 | 330 | - |
| 1/2 | 45 | 40 | 260 | 440 | - |
| 3/4 | 50 | 45 | 320 | 570 | - |
| 1 | 57-60 | 48-56 | 400 | 640 | 1910 |
| 1-1/2 | 60-64 | 54-61 | 490 | 776 | 2075 |
| 2 | 61-71 | 57-78 | 642 | 1123 | 2340 |
| 3 | 77 | 87 | - | - | 4230 |
| 4 | 77 | 102 | - | - | 5180 |
| 6 | 96 | 105 | - | - | 7200 |
| 8 | 96 | 123 | - | - | 8000 |

1 cu. yd = .76m3

1 in. = 25.4 mm

1 pound = .45 kg

*LW: Lightweight Buckets, useful with small cranes

*GP: General Purpose, low-cost bucket

*HW: Heavyweight Bucket, used for concrete with large aggregates or low slump

(reinforced concrete = 150 lb./cu. ft. = 4050 lbs./cu. yd. = 2403 kg/m3)

## Weights of Seamless and Welded Pipe

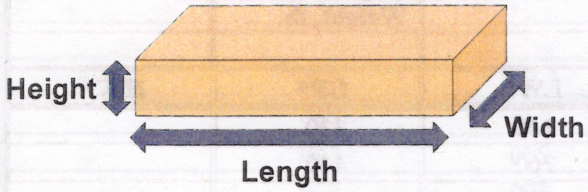
| Nominal Pipe Size | STD. Wt. | X.S. Wt. | X.X.S. Wt. | 10 Wt. | 20 Wt. | 30 Wt. | 40 Wt. | 60 Wt. | 80 Wt. | 100 Wt. | 120 Wt. | 140 Wt. | 160 Wt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 3.65 | 5.02 | 9.03 | | | | 3.65 | | 5.02 | | | | 7.46 |
| 2-1/2 | 5.79 | 7.66 | 11.7 | | | | 5.79 | | 7.66 | | | | 10.01 |
| 3 | 7.58 | 10.25 | 18.58 | | | | 7.58 | | 10.25 | | | | 14.31 |
| 3-1/2 | 9.11 | 12.51 | | | | | 9.11 | | 12.51 | | | | |
| 4 | 10.79 | 14.98 | 27.54 | | | | 10.79 | | 14.98 | | 18.98 | | 22.52 |
| 5 | 14.62 | 20.78 | 38.55 | | | | 14.62 | | 20.78 | | 27.04 | | 32.96 |
| 6 | 18.97 | 28.57 | 53.16 | | | | 18.97 | | 28.57 | | 36.42 | | 45.34 |
| 8 | 28.55 | 43.39 | 72.42 | | 22.36 | 24.7 | 28.55 | 35.66 | 43.39 | 50.93 | 60.69 | 67.79 | 74.71 |
| 10 | 40.48 | 54.74 | 104.13 | | 28.04 | 34.24 | 40.48 | 54.74 | 64.4 | 77 | 89.27 | 104.13 | 115.65 |
| 12 | 49.56 | 65.42 | 125.49 | | 33.38 | 43.77 | 53.56 | 73.22 | 88.57 | 107.29 | 125.49 | 139.68 | 160.33 |
| 14 | 54.57 | 72.09 | | 36.71 | 45.68 | 54.57 | 63.37 | 85.01 | 106.13 | 130.79 | 150.76 | 170.22 | 189.15 |
| 16 | 62.58 | 82.77 | | 42.05 | 52.36 | 62.58 | 82.77 | 107.54 | 136.58 | 164.86 | 192.4 | 223.57 | 245.22 |
| 18 | 70.59 | 93.45 | | 47.39 | 59.03 | 82.06 | 104.76 | 138.17 | 170.84 | 208 | 244.14 | 274.3 | 308.55 |
| 20 | 78.60 | 104.13 | | 52.73 | 78.6 | 104.13 | 123.06 | 166.5 | 208.92 | 256.15 | 296.37 | 341.1 | 379.14 |
| 22 | 86.61 | 114.81 | | 58.07 | 86.61 | 114.81 | | 197.42 | 250.82 | 302.88 | 353.61 | 403.01 | 451.07 |
| 24 | 94.62 | 125.49 | | 63.41 | 94.62 | 140.8 | 171.17 | 238.29 | 296.53 | 367.45 | 429.5 | 483.24 | 542.09 |
| 26 | 102.63 | 136.17 | | 85.73 | 136.17 | | | | | | | | |
| 28 | 110.64 | 146.85 | | 92.41 | 146.85 | 182.73 | | | | | | | |
| 30 | 118.65 | 157.53 | | 99.08 | 157.53 | 196.08 | | | | | | | |
| 32 | 126.66 | 168.21 | | 105.76 | 168.21 | 209.43 | 229.92 | | | | | | |
| 34 | 134.67 | 178.89 | | 112.43 | 178.89 | 22.78 | 244.6 | | | | | | |
| 36 | 142.68 | 189.57 | | 119.11 | 189.57 | 236.13 | 282.36 | | | | | | |
| 42 | 166.71 | 221.61 | | | 221.61 | 276.17 | 330.41 | | | | | | |

Pipe weights shown above are give for a lineal foot of plain end pipe

To convert lbs/ft to metric: 1 lb/ft = 1.49 kg/m

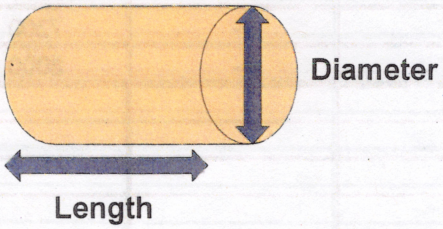
## Calculating the volume of a box:

Volume = Length x Width



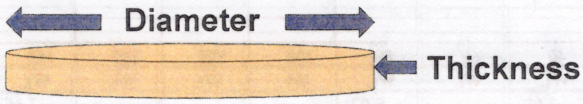

## Calculating volume of a solid cylinder:

$$\text{Volume} = 3.14 \times \left(\frac{\text{diameter} \times \text{diameter}}{4}\right) \times \text{length}$$



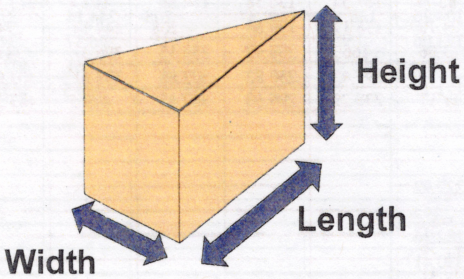

## Calculating volume of a round solid flat plate:

$$\text{Volume} = 3.14 \times \left(\frac{\text{dia.} \times \text{dia.}}{4}\right) \times \text{thickness}$$



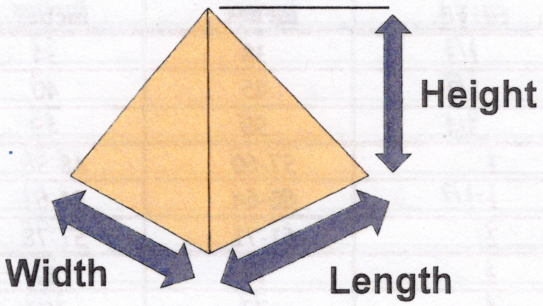

## Calculating volume of a wedge:

$$\text{Volume} = \left(\frac{\text{width} \times \text{length}}{2}\right) \times \text{height}$$



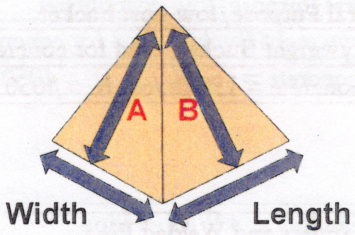

## Calculating volume of a solid pyramid:

$$\text{Volume} = \left(\frac{\text{height}}{3}\right) \times \text{width} \times \text{length}$$



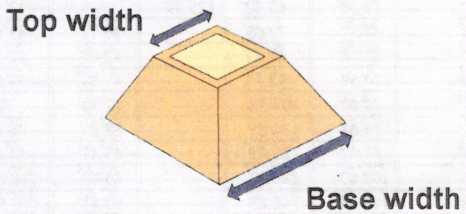

## Calculating volume of a hollow pyramid (no base):

Volume = (A x width) x (B x length) x thickness of walls



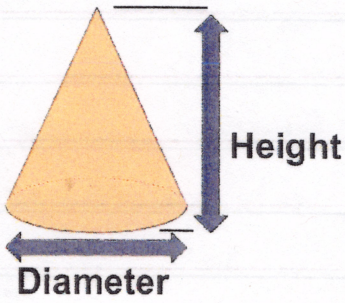

## Calculating volume of a hollow truncated pyramid (no base):

$$\text{Volume} = \left(\frac{\text{top} + \text{base}}{2}\right) \times \text{thickness} \times \#\ \text{of sides of walls}$$



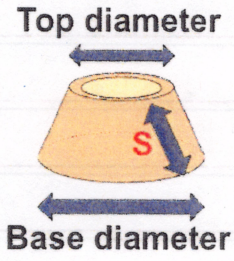
## Calculating volume of a solid cone:

$$\text{Volume} = 3.14 \times \left(\frac{\text{dia.} \times \text{dia.}}{4}\right) \times \frac{\text{height}}{3}$$




## Calculating volume of a hollow cone (without base):

$$\text{Volume} = 3.14 \times \left(\frac{\text{top} + \text{base}}{2}\right) \times \text{Side length} \times \text{thickness}$$




***Using a simple calculator, practice performing volume calculations by completing the work sheets in Appendix B.***

## Case Study

This truck crane toppled over on to a home in Newark, N.J. when a tree removal company was cutting down a very large tree in the backyard. When the truck driver attempted to use the crane to lift up the cut-up pieces of the tree, the crane tipped over and fell into the house. The truck also toppled on to the side. The crane engineer apparently did not properly judge the weight of the logs, which were too heavy for the crane to handle.

Notes: